VARIATIONS IN RARE EARTH ELEMENT (REE) SIGNATURES AND UNIT CELL DIMENSIONS (UCD) FOR PURPOSES OF STRATIGRAPHIC CORRELATION IN THE PIERRE SHALE, SOUTH DAKOTA

Doreena Patrick  
Geochemical Solutions, LLC  
North Wales, PA 19454

Paul N. Wegleitner  
Geochemical Solutions, LLC  
Fort Pierre, SD 57532

James E. Martin  
Museum of Geology  
South Dakota School of Mines and Technology  
Rapid City, SD 57701

ABSTRACT

Our recent research has involved various methods for stratigraphic correlation and paleoenvironmental interpretation including Rare Earth Element (REE) analysis of fossil bioapatites and now unit cell dimension analysis (UCDA). REE analysis and UCDA in fossil bioapatite uses variations in REE signatures and unit cell dimensions within fossil bioapatite from various stratigraphic units. The REE composition and UCD are dependent upon conditions of the original diageneric waters and thus dependent upon availability of REE and other species for substitution during the per mineralization of the bioapatite. The REE signature and the UCD variations identify distinct intervals within lithologic formations. Because these intervals represent an averaging of periods of certain depositional environments, these distinct intervals can be correlated over significant areas.

Fossil vertebrate samples were obtained from the Pierre Shale, in an area between Chamberlain and Pierre, South Dakota, at localities along the banks of the Missouri River in Brule, Buffalo, Hughes, and Hyde counties. Vertebrate samples were collected from the lower, middle and upper Sharon Springs, Gregory, Crow Creek, lower and upper DeGrey and Verendrye members of the Pierre Shale. REE signatures and UCD variations were found to be consistent within individual lithostratigraphic units but are significantly different between units. REE signatures and UCD act as markers for their units and can be used to discriminate between units for purposes of stratigraphic correlation. The REE analyses and UCDA resulting from our research provides for a finer scale of resolution for stratigraphic correlation and a proxy for paleoenvironmental interpretation.